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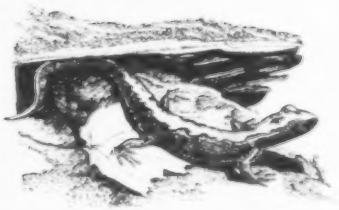
Southern Headwaters at Risk Project (SHARP) Amphibian and Western Painted Turtle (*Chrysemys picta*) Surveys, 2003-2004



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Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

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Southern Headwaters At Risk Project (SHARP) Amphibian and Western Painted Turtle (*Chrysemys picta*) Surveys, 2003 - 2004

K. J. Pearson

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Cover Illustration by: Brian Huffman

For copies of this report, contact:

Information Centre- Publications
Alberta Environment/Alberta Sustainable Resource Development
Main Floor, Great West Life Building
9920- 108 Street
Edmonton, Alberta, Canada T5K 2M4
Telephone: (780) 422-2079

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EXECUTIVE SUMMARY

The Southern Headwaters At Risk Project (SHARP) is a multi-species approach to the management and conservation of species at risk in the headwater region of the Oldman River in southwestern Alberta. In 2003-2004, the objectives of the amphibian component of SHARP were to investigate and describe the distribution of amphibians in the SHARP area. This was accomplished by conducting a series of visual encounter and call surveys at 121 waterbodies. Additional amphibian occurrence data were collected from several other sources and combined with SHARP survey data to produce a series of amphibian species distribution maps for the SHARP area. Based upon a literature review, a series of land use guidelines for amphibian habitat protection in the SHARP area were established.

A number of anecdotal records of western painted turtle in the Crowsnest Pass portion of the SHARP area exist, however the extent of the turtles' distribution has not been formally surveyed. Further, the origins of western painted turtle in the SHARP area are uncertain. Western painted turtle surveys were completed at seven locations in the Crowsnest Pass area in 2004; turtles were identified at one site. A number of area locals were also interviewed to obtain information on the distribution and origins of the turtles. Based on the results of those interviews, western painted turtles may have colonized the Crowsnest Pass region from British Columbia, while intentional introductions may have taken place as well. Alternatively, turtles may have been established in the vicinity of Lee Lake, and subsequently expanded westward through the Crowsnest Pass.

1.0 Introduction

North America's freshwater fauna are undergoing extinctions at an unprecedented rate; one that is several times higher than those of terrestrial and marine faunas (Ricciardi and Rasmussen 1999). In particular, scores of amphibian declines and extinctions have been observed on a global scale since the 1970s (Wake 1991). In North America, approximately 0.2% of amphibian species are experiencing extinctions per decade; that rate is expected to increase to approximately 3.0% in the coming century (Ricciardi and Rasmussen 1999). Seven (70%) of Alberta's ten amphibian species are regarded provincially as not *Secure* (Alberta Sustainable Resource Development 2000).

The Southern Headwaters At Risk Project (SHARP) is a multi-species approach to the management and conservation of species at risk in the headwater region of the Oldman River (Blouin 2004). The SHARP area is the region south of Nanton and Highway #532 to the United States border and Waterton Lakes National Park, and west of Highway #2 to the continental divide (Blouin 2004). The SHARP area thus includes a diversity of natural regions (fescue and mixed grasslands, foothills parkland, montane, subalpine and alpine) which make it host to high amphibian diversity. Eight of Alberta's ten amphibian species currently inhabit the SHARP area. The status of each SHARP area amphibian species, as designated by Alberta Sustainable Resource Development (ASRD 2000), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2004) and the Alberta Natural Heritage Information Centre (ANHIC 2004), is listed in Table 1.

Table 1. SHARP area amphibian species status designated by ASRD, COSEWIC and ANHIC. Designation definitions are listed in Appendix A.

Species name	ASRD Status	ANHIC Status	COSEWIC Status
Long-toed salamander	Sensitive	S3 (Tracking)	Not listed
Tiger salamander	Secure	S4 (Watch)	Not At Risk
Western toad	Sensitive	S4 (Watch)	Special Concern
Plains spadefoot	May Be At Risk	S3 (Watch)	Not At Risk
Striped chorus frog	Secure	Not listed	Not listed
Northern leopard frog	At Risk	S2/S3 (Tracking)	Special Concern
Wood frog	Secure	Not listed	Not listed
Columbia spotted frog	Sensitive	S3 (Tracking)	Not At Risk

Amphibians maintain important functions in both terrestrial and aquatic ecosystems and are well-recognized indicators of ecological integrity. For example, amphibian movements between aquatic and terrestrial habitats are significant vectors for nutrient flow (Semlitsch 2003; Davic and Welsh 2004). Salamanders contribute to soil dynamics through their association with underground burrows (Davic and Welsh 2004). Further, amphibians occupy important niches in the food web as grazers, predators,

competitors and prey (Semlitsch 2003b). Amphibian declines may therefore have widespread consequences. For example, amphibian populations greatly reduced by introduced fish in the Sierra Nevada have been correlated with the decline of garter snakes in that area (Matthews et al. 2002).

The western painted turtle (*Chrysemys picta*) is listed as *Sensitive* in Alberta (Alberta Sustainable Resource Development 2000). The Alberta distribution of western painted turtle is patchy; populations have been identified at the Crowsnest Pass, Oldman River valley in Lethbridge, Milk River drainage, Cypress Hills, Banff National Park, Edmonton and Hines Creek (Russell and Bauer 1993). Russell and Bauer (1993) reported that the Milk River population was the only natural occurrence of the species in Alberta and that the other populations may have been introduced. Western painted turtles are distributed across the southern portion of British Columbia (BC); it may be possible that the turtles observed in the Crowsnest Pass area have naturally colonized from BC, or that they were transferred there as unwanted pets. If the turtles have been introduced they may be negatively affecting those ecosystems through mechanisms such as predation and/or competition. It is difficult to make appropriate management decisions without a clear idea of the population's origins. No formal surveys of western painted turtle in the SHARP area have been completed.

The primary objectives of the 2003-2004 SHARP amphibian and western painted turtle survey components were:

- to investigate and describe the distribution of amphibians in the SHARP area,
- to investigate the distribution and origins of western painted turtle in the SHARP area, and
- to establish a series of land use guidelines for amphibian habitat protection in the SHARP area

2.0 Methods

2.1 Amphibian Presence/No Detection Surveys

A number of amphibian surveys have previously been conducted in the SHARP area (e.g. Nelson et al. 1995; Oseen et al. 1995; Paton 2001; Pearson 2003). To further investigate current amphibian distributions, a series of field surveys were conducted in 2003 and 2004. Because of the SHARP area's large size, 2003 surveys took place within the southern portion of the SHARP area (south of Highway #3), while 2004 surveys focused north of Highway #3.

In 2003, amphibian presence/no detection surveys were conducted at 22 waterbodies located on provincial crown land (Castle Special Management Area, Beauvais Lake Provincial Park, Police Outpost Provincial Park) and at 24 waterbodies

located on privately-owned properties. Closures due to the Lost Creek Fire limited the number of surveys conducted in the Castle Special Management Area in August, 2003.

In 2004, amphibian presence/no detection surveys were completed at 21 waterbodies located on provincial crown land (Rocky Mountain Forest Reserve, Castle Special Management Area), at 8 waterbodies located on the Waldron Grazing Co-op, and at 16 waterbodies located on privately-owned properties. Twenty additional locations on private land were also call-surveyed, primarily for plains spadefoot.

Surveyed waterbodies were chosen either because there was no record available of them being surveyed previously, or in order to obtain current amphibian information at previously-examined locations. All waterbodies were surveyed using visual encounter shoreline survey and/or call survey methods.

Visual encounter surveys were conducted April-August, 2003 and April-May and July-September, 2004, following the methods described by Thoms et al. (1997). The entire perimeter of each waterbody was examined by at least one qualified surveyor and all amphibian eggs, larvae, juveniles and adults were recorded. Long-handled dipnets were used to sweep for amphibian larvae in areas of thick emergent or submerged vegetation (one sweep per 5 m of heavily-vegetated shoreline). Calling adults were also recorded. All field equipment was disinfected with a bleach solution between survey sites in order to prevent the transmission of pathogens. Permission to access waterbodies on private lands was obtained prior to surveys taking place. One to three visual encounter surveys were conducted per site.

In 2003, call surveys were conducted at ten historic and potential northern leopard frog sites, following the protocol described by Kendell (2002). Call surveys were carried out in late May and early June, 2003; snow and cold temperatures prior to that were not favourable for leopard frog breeding activity. All call surveys were at least ten minutes in duration. One call survey was conducted per site.

Unsuitable weather in spring, 2004 precluded regular amphibian call surveys, however heavy rains in May, 2004 made for excellent conditions for plains spadefoot activity. Call surveys for plains spadefoot were completed along two road transects in late May, 2004. The road transects were located west of Mud Lake and south of McBride Lake. Both transects were located in areas containing numerous waterbodies and within the mixedgrass subregion. Call surveys were also completed at two additional historic plains spadefoot sites near Pincher Creek and Claresholm. Plains spadefoot call surveys were conducted following the methods described by Taylor and Downey (2003).

2.2 Amphibian Distribution Mapping

Amphibian data collected in 2003-2004 were entered into an MS Excel database. Additional amphibian occurrence data were collected from the ANHIC database, the Biodiversity/Species Observation Database (BSOD), Lars Brinkmann of the University of Lethbridge (pers. comm. 2004), Nelson et al. (1995), Oseen et al. (1995), Paton

(2001), Parks Canada (2003), Pearson (2003), Snyder et al. (2003) and Taylor and Smith (2003). Waterton Lakes National Park (WLNP) is not formally included in the SHARP area, however it is an integral component of the Crown of the Continent ecosystem and provides a relatively less disturbed land base with which to make comparisons. WLNP amphibian data were therefore included in this summary to provide a comprehensive overview of amphibian status and distribution in southwestern Alberta (Parks Canada 2003).

These additional data were combined with the 2003-2004 data in a separate database in order to produce a series of species distribution maps that depict historic (prior to 1995) and present (since 1995) species ranges. Approximate site locations were mapped using a Geographic Information System. To demonstrate areas of potential declines or where recent surveys have not been conducted, species observations made prior to 1995 were considered separately from those made during and since 1995. Many, but not all, of the locations that were surveyed prior to 1995 have been surveyed subsequently. These data thus cannot define trends, but can provide some indication of the former/present abundance or decline of the various species.

2.3 Western Painted Turtle Surveys

Surveys for western painted turtle were conducted at seven locations in the Crowsnest Pass area, Lee Lake and Beauvais Lake. Waterbodies surveyed were those where turtles have previously been observed. Turtle surveys were completed in May and August, 2004. The shoreline of each waterbody was surveyed for basking turtles by scanning with binoculars (British Columbia Ministry of Environment, Lands and Parks 1998). Informal conversations were initiated with four Crowsnest Pass area locals to obtain their knowledge on the origins and distribution of western painted turtle.

2.4 Land Use Guidelines

Background information on SHARP area amphibian habitat associations and limiting factors was compiled by conducting a literature review (section 5.1). Based on that information, a series of land use guidelines for the protection of amphibian habitat in the SHARP area was created (section 5.2).

3.0 Results

3.1 Amphibians

With the exception of the northern leopard frog, all amphibian species were observed at a greater proportion of the surveyed sites since 1995 than prior to 1995. Table 2 is a summary of the number and proportion of sites where each amphibian species was present prior to and since 1995, or was not detected during amphibian surveys. Figures 1 through 8 depict the approximate locations of species observations and the general distribution of each species within the SHARP area and Waterton Lakes National Park.

Specific site information is sensitive and is not included in this report. Site location data are stored with the Regional Species At Risk Biologist in Lethbridge and in BSOD.

Since 1995, long-toed salamanders (*Ambystoma macrodactylum*) were detected at 28% of the 648 sites (Figure 1), in the foothills parkland, montane and subalpine subregions of the Rocky Mountains and foothills. In contrast, tiger salamanders (*Ambystoma tigrinum*) were observed at 4% of the surveyed sites (Figure 2). All locations where tiger salamanders were present were in the foothills parkland and montane subregions.

Western toads (*Bufo boreas*) were detected at 19% of surveyed sites in the fescue grassland, foothills parkland, montane and subalpine natural subregions since 1995 (Figure 3). Hundreds of plains spadefoot (*Spea bombifrons*) were heard calling along the Mud Lake transect in 2004, which represents 1% of the sites for which amphibian survey data are available in the SHARP area since 1995. Plains spadefoot were not detected during call surveys at two historic plains spadefoot sites. All plains spadefoot were observed in the mixedgrass subregion (Figure 4).

Table 2. Summary of available amphibian survey data for the SHARP area and Waterton Lakes National Park. Percentages are the proportion of the 648 locations surveyed between 1946 and 2004.

	LTSA*	TISA*	WETO*	PLSP*	SCFR*	NLFR*	WOFR*	CSFR*
# of sites present at prior to 1995	7 (1%)	0 (0%)	0 (0%)	2 (0.3%)	0 (0%)	41 (6%)	0 (0%)	12 (2%)
# of sites present at since 1995	184 (28%)	27 (4%)	121 (19%)	8 (1%)	128 (20%)	13 (2%)	3 (0.4%)	214 (33%)
# surveyed sites not detected at	457 (71%)	621 (96%)	527 (81%)	638 (98%)	520 (80%)	594 (92%)	645 (99%)	422 (65%)

* LTSA = long-toed salamander, TISA = tiger salamander, WETO = western toad, PLSP = plains spadefoot, SCFR = striped chorus frog, NLFR = northern leopard frog, WOFR = wood frog, CSFR = Columbia spotted frog

Striped chorus frogs (*Pseudacris maculata*) were present at 20% of surveyed sites since 1995. No records of striped chorus frog were noted for the SHARP area prior to 1995. This is likely because pre-1995 surveys focused on areas outside of the frog's range. Since 1995, that species' distribution was concentrated in the foothills parkland subregion of WLNP and the mixedgrass subregion near Stavely (Figure 5). Northern leopard frogs (*Rana pipiens*) were observed at 6% and 2% of surveyed sites prior to 1995 and since 1995, respectively (Figure 6). Most northern leopard frogs were observed in the fescue grassland and mixedgrass subregions, while some were in the foothills parkland and montane subregions. Wood frogs were present at fewer than 1% of the post-1995 surveyed sites (Figure 7); all of those observations were made during 2004 surveys. All

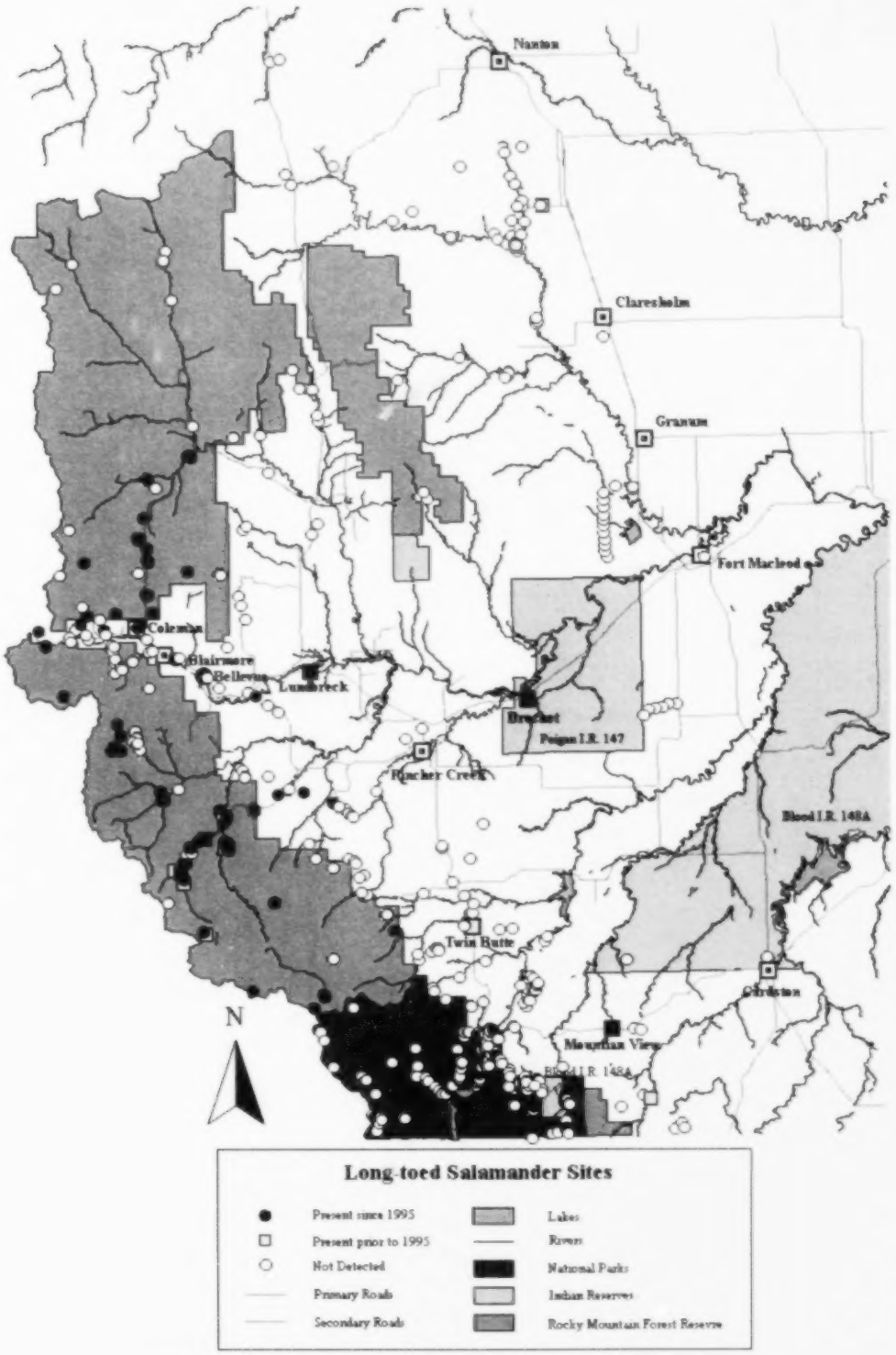


Figure 1. Long-toed salamander distribution in the SHARP area and Waterton Lakes National Park.

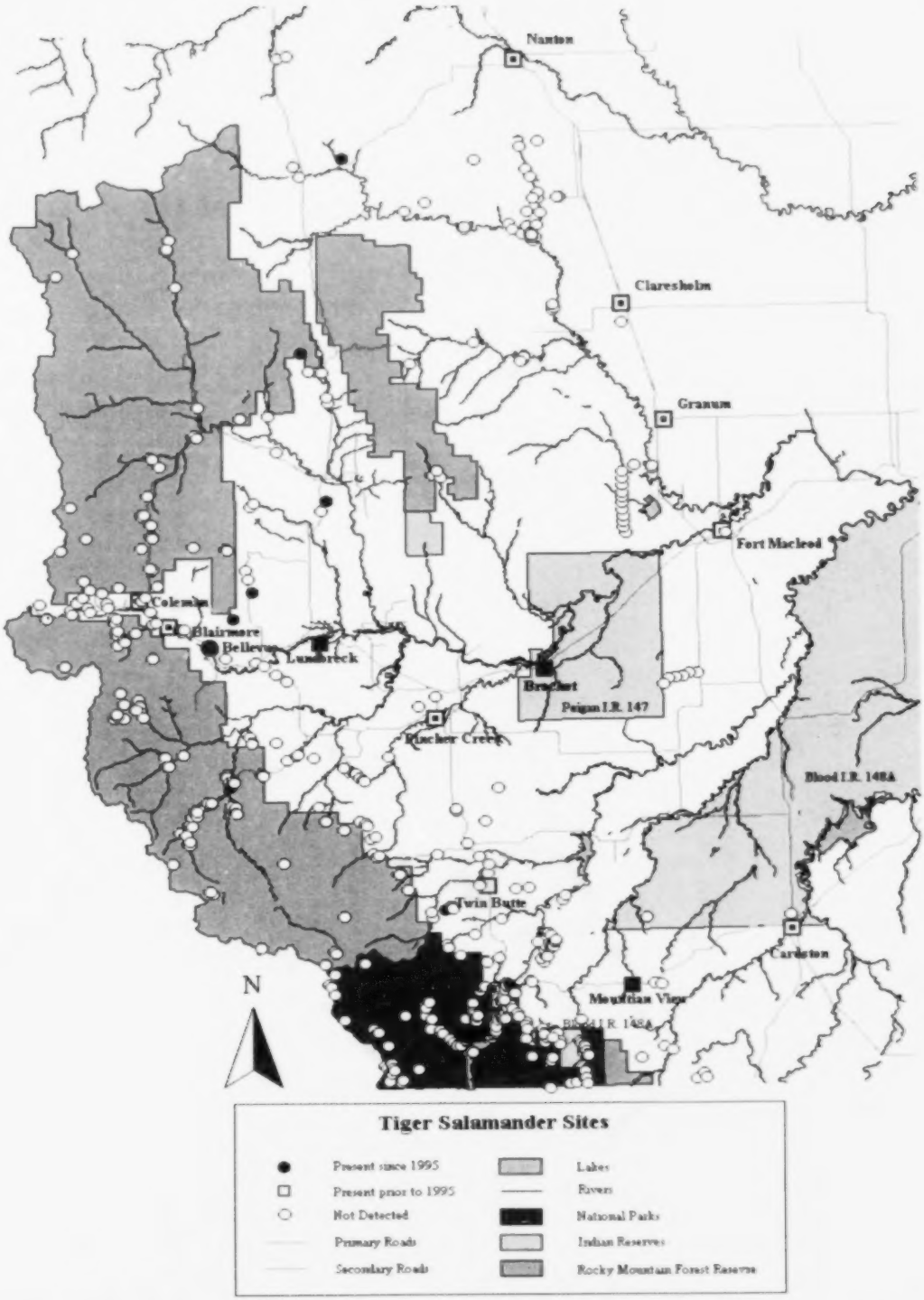


Figure 2. Tiger salamander distribution in the SHARP area and Waterton Lakes National Park.

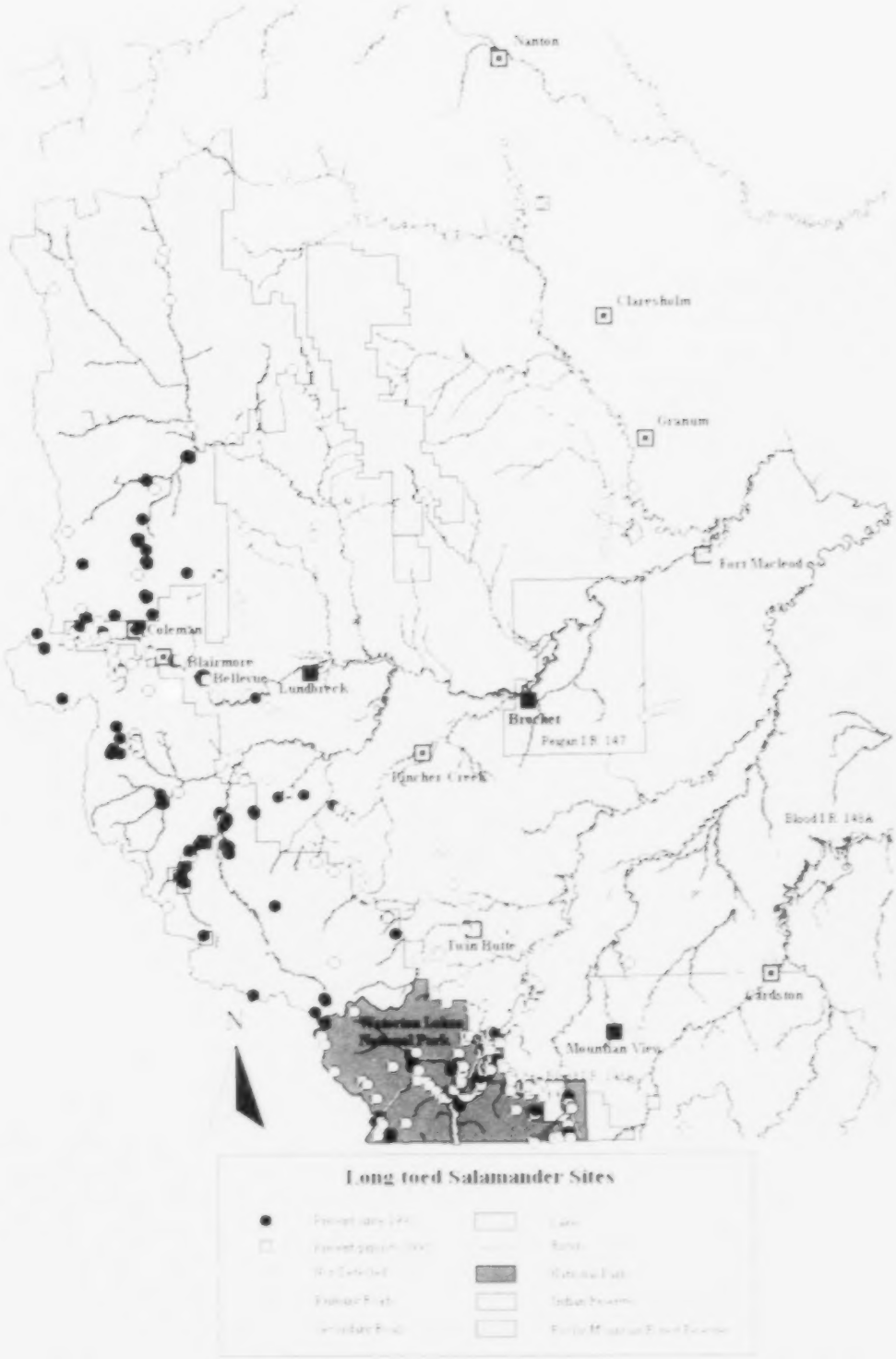


Figure 1. Long-toed salamander distribution in the SHARP area and Waterton Lakes National Park.

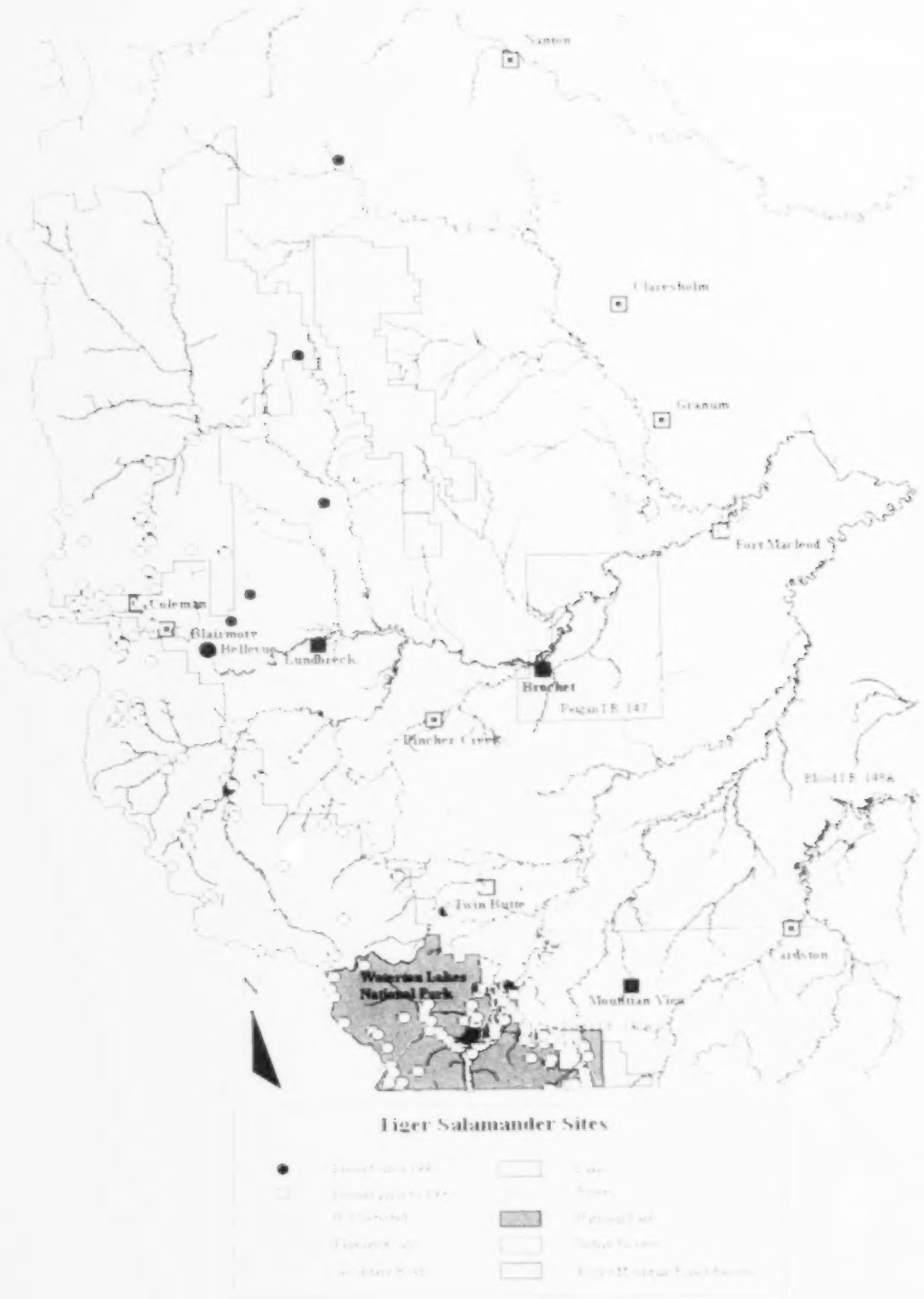


Figure 2. Tiger salamander distribution in the SHARP area and Waterton Lakes National Park.

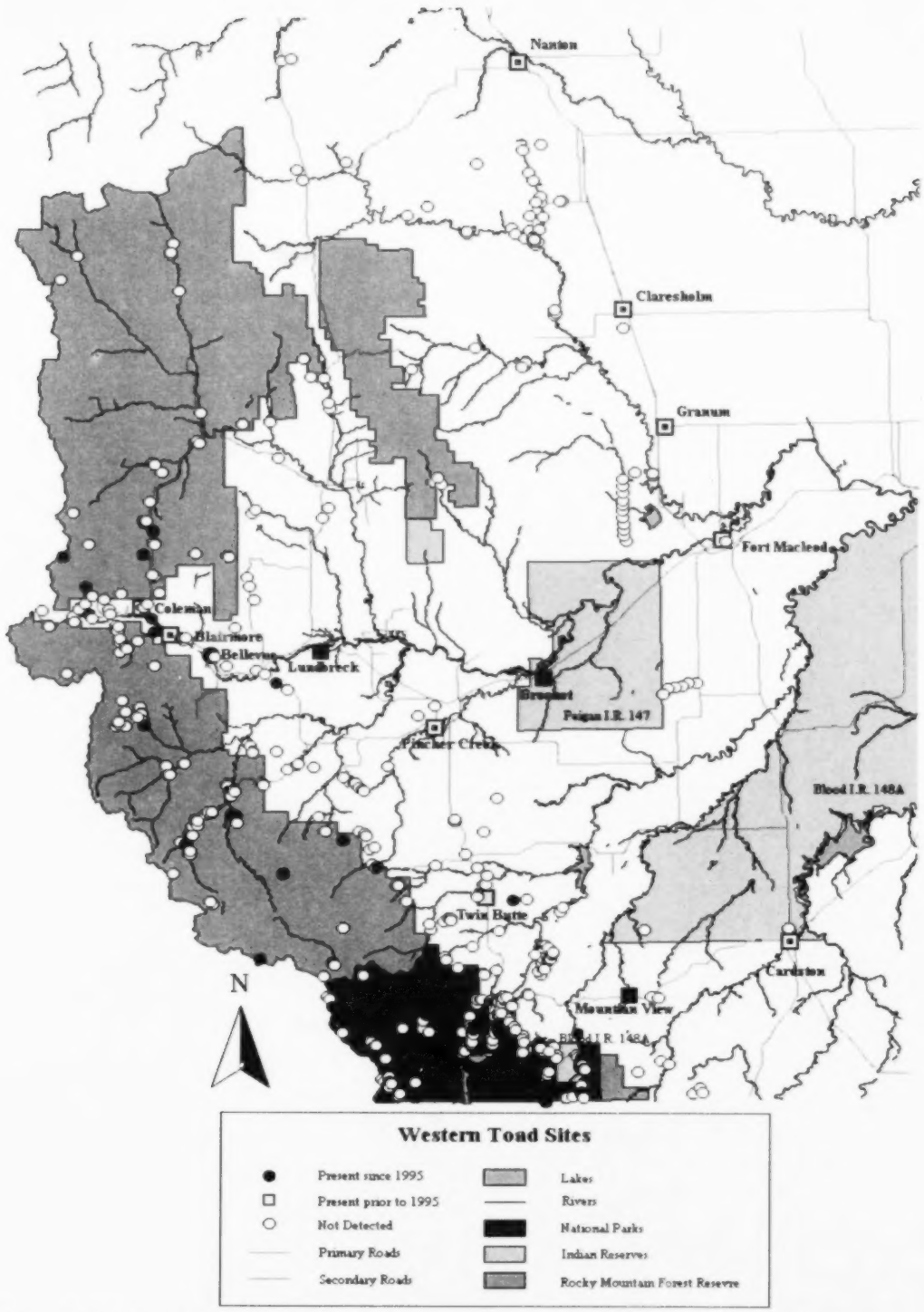


Figure 3. Western toad distribution in the SHARP area and Waterton Lakes National Park.

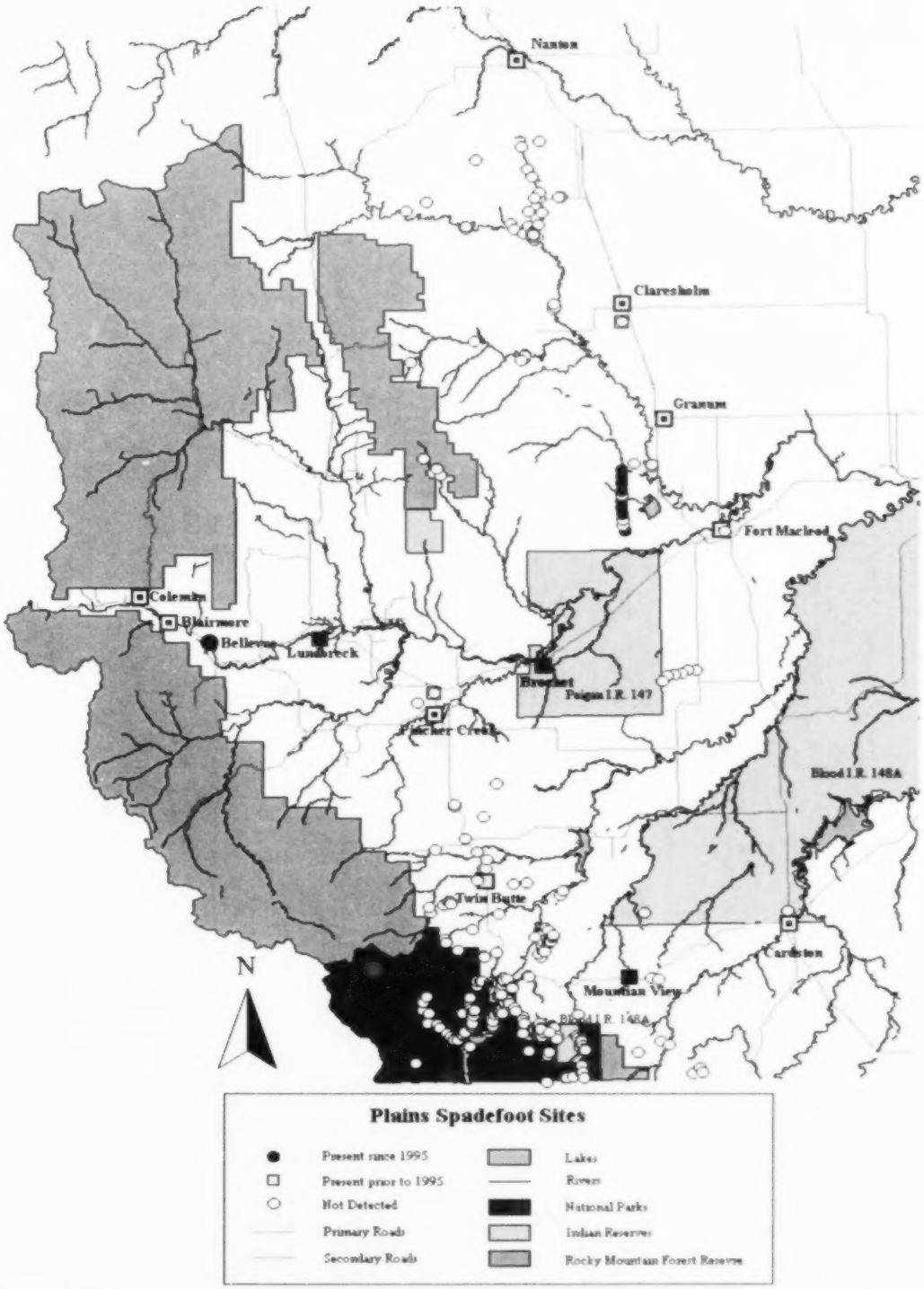


Figure 4. Plains spadefoot distribution in the SHARP area and Waterton Lakes National Park.

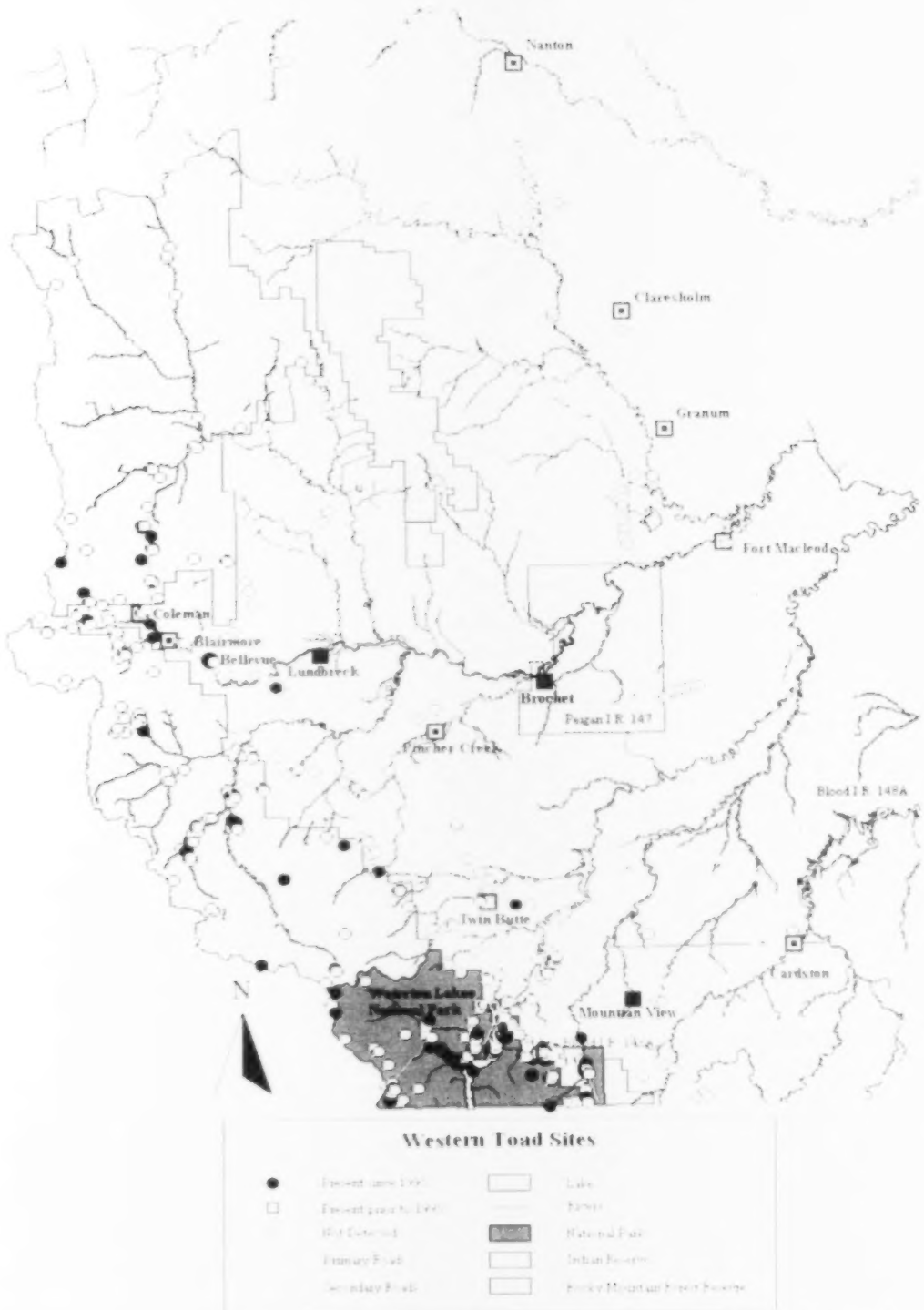


Figure 3. Western toad distribution in the SHARP area and Waterton Lakes National Park.

Figure 4. Plains spadefoot distribution in the SHARP area and Waterton Lakes National Park.

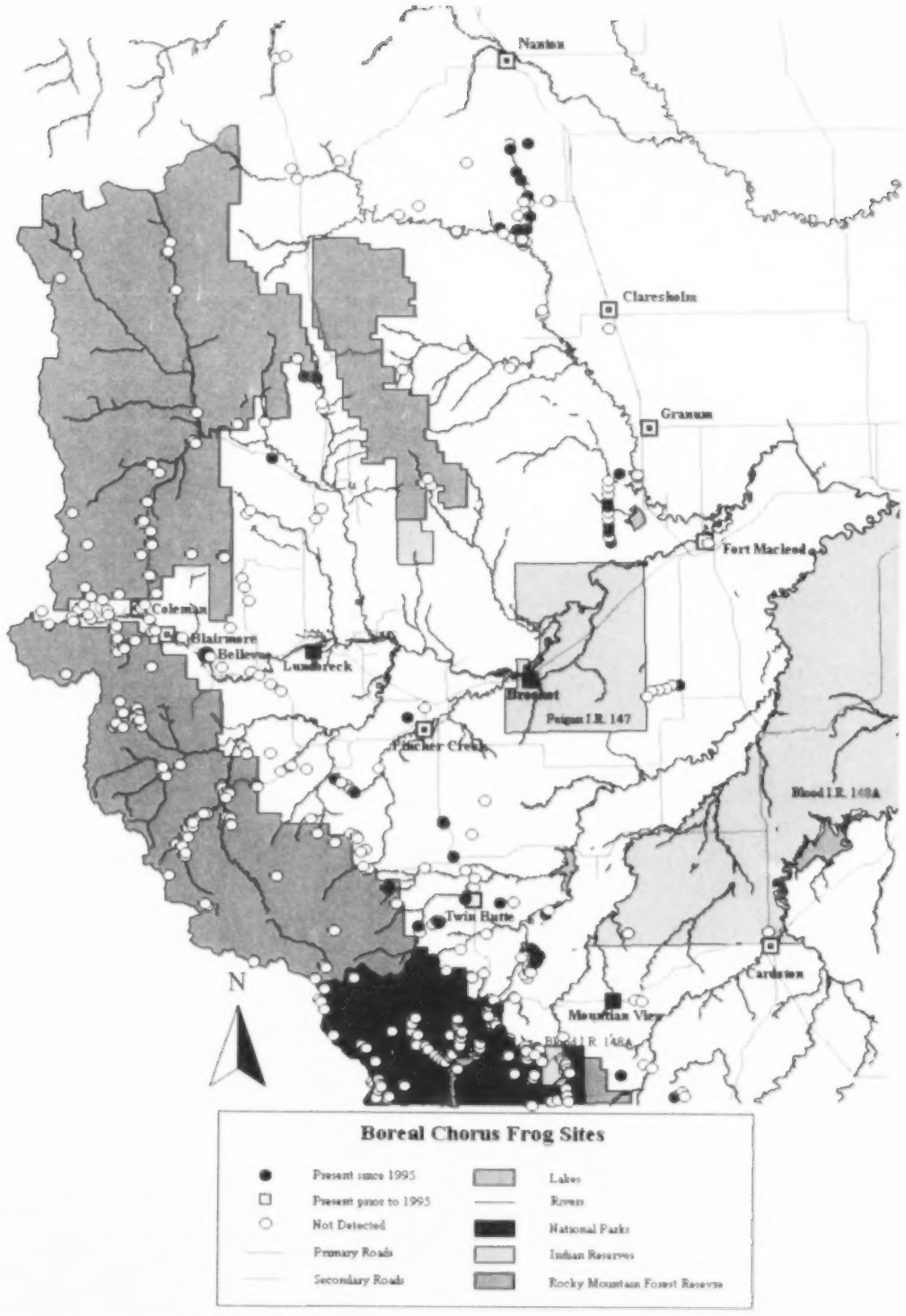


Figure 5. Striped (boreal) chorus frog distribution in the SHARP area and Waterton Lakes National Park.

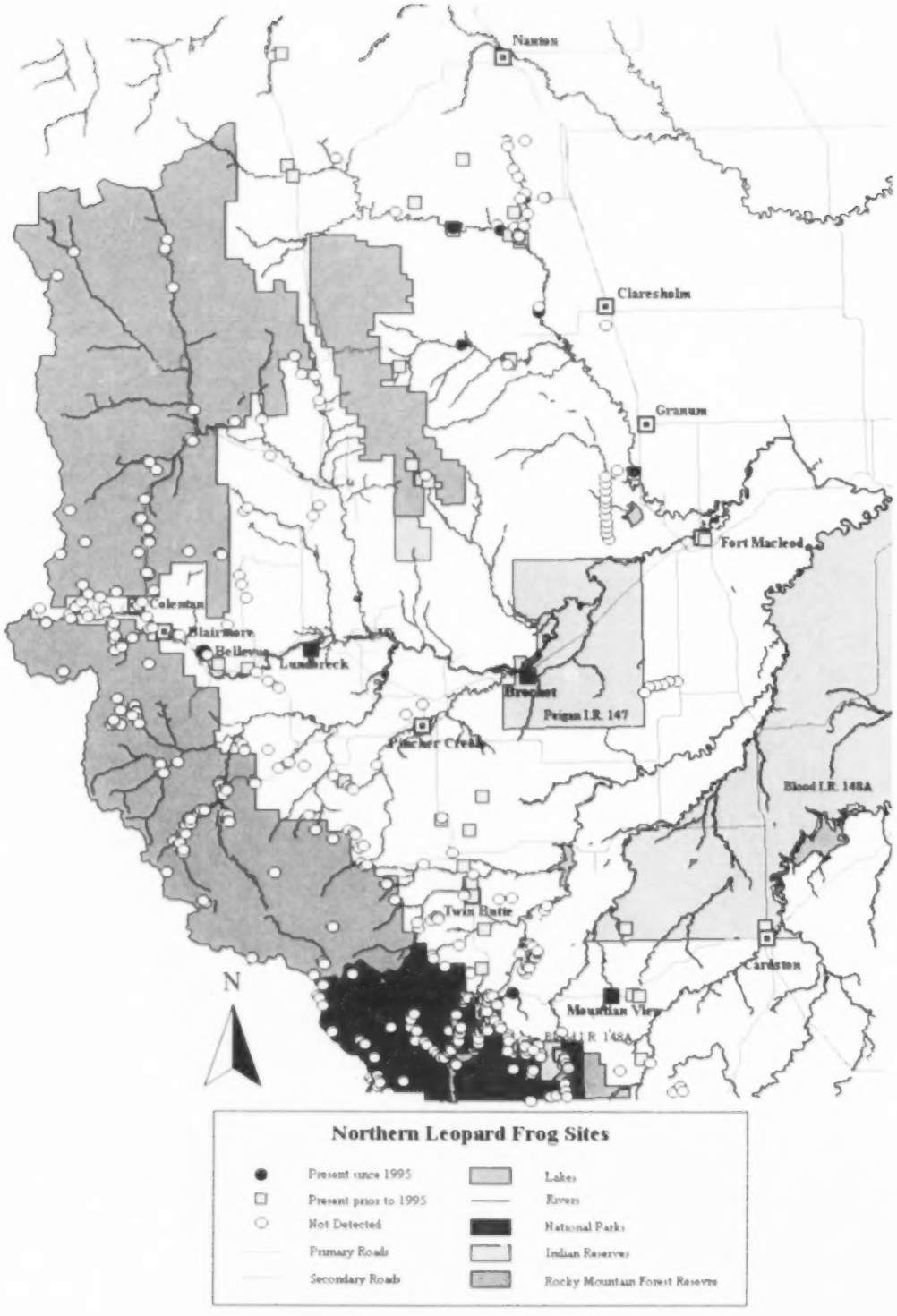
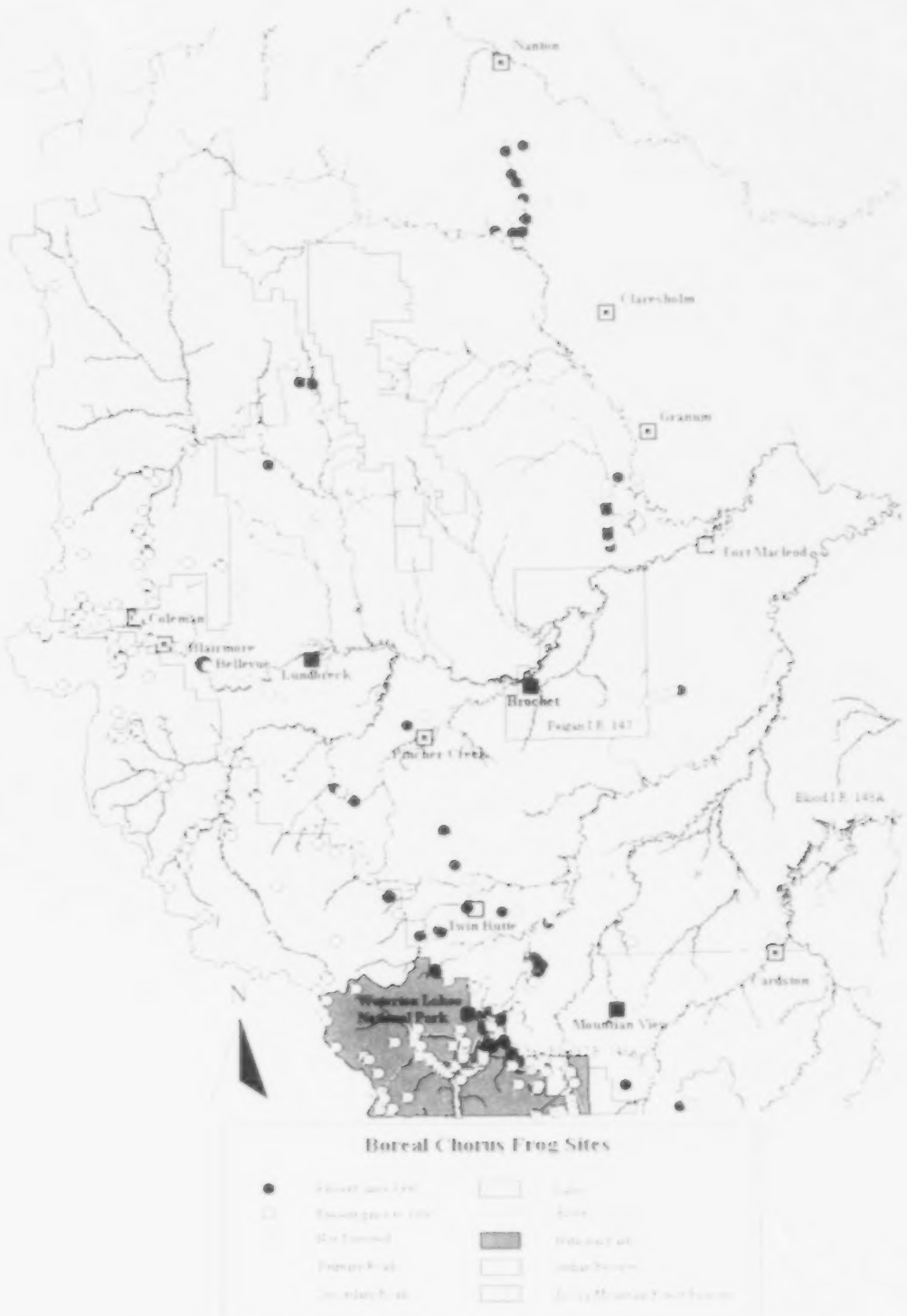


Figure 6. Northern leopard frog distribution in the SHARP area and Waterton Lakes National Park.



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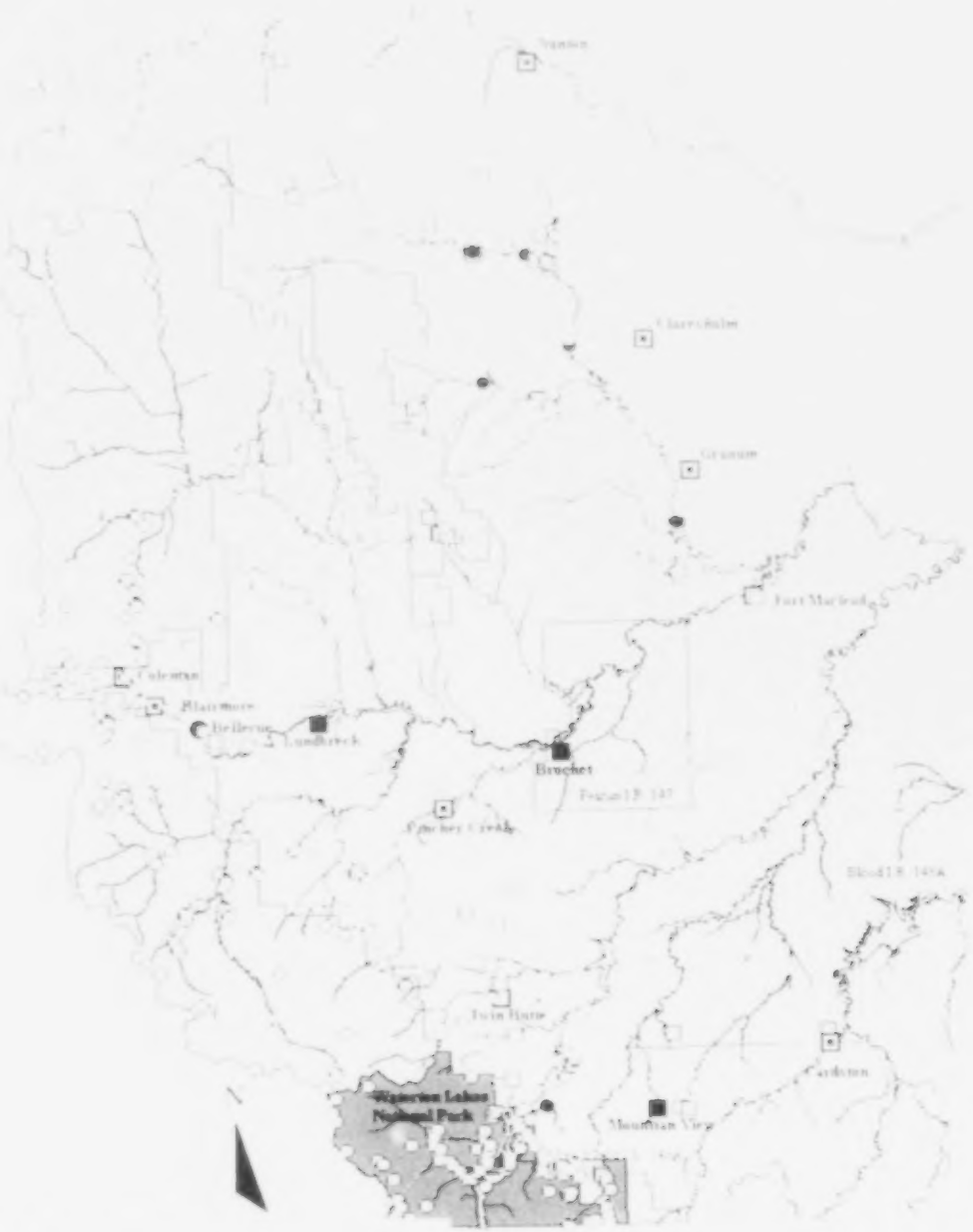

Figure 6. Northern leopard frog distribution in the SEARP area and Waterton Lakes National Park.

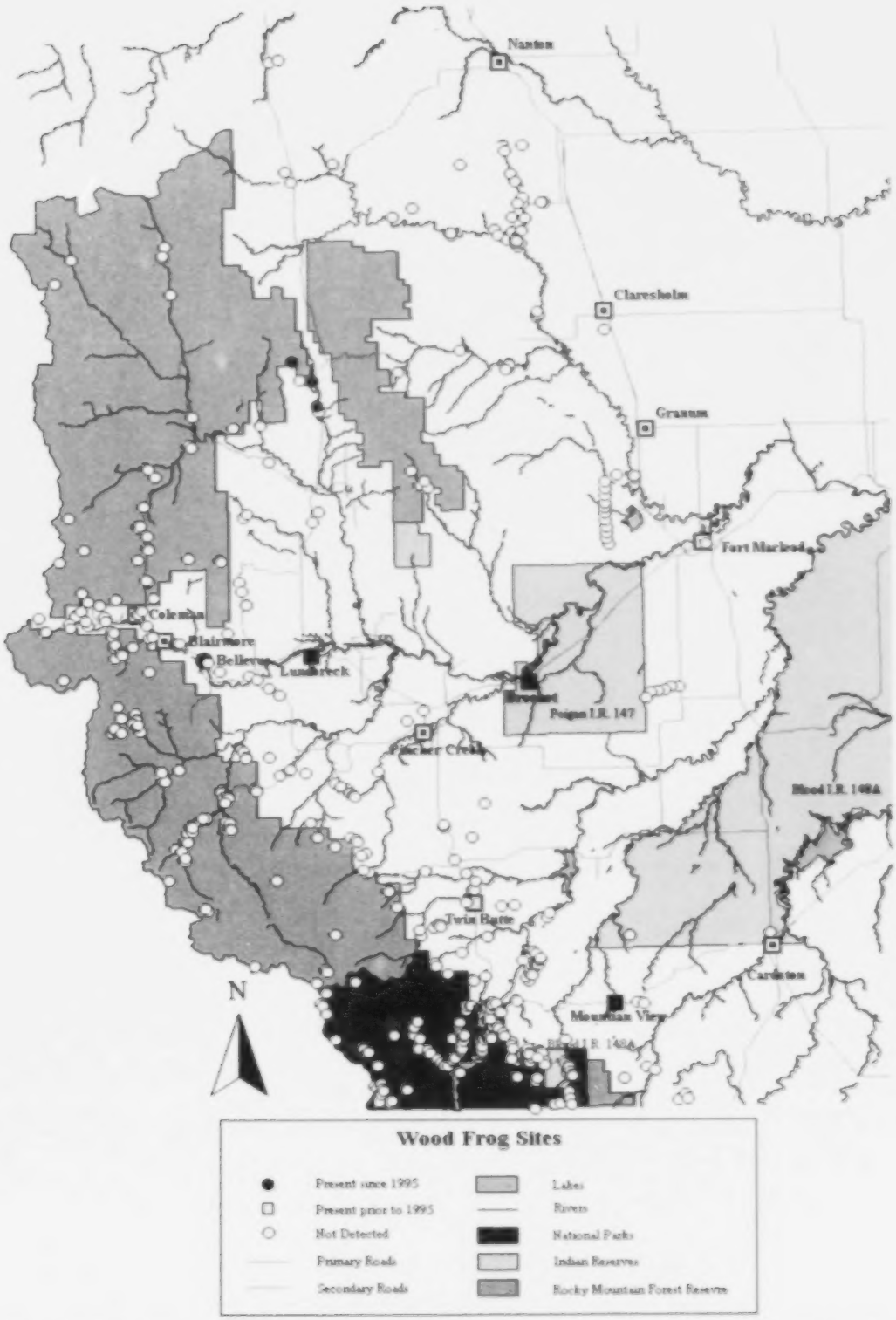

Figure 7. Wood frog distribution in the SHARP area and Waterton Lakes National Park.

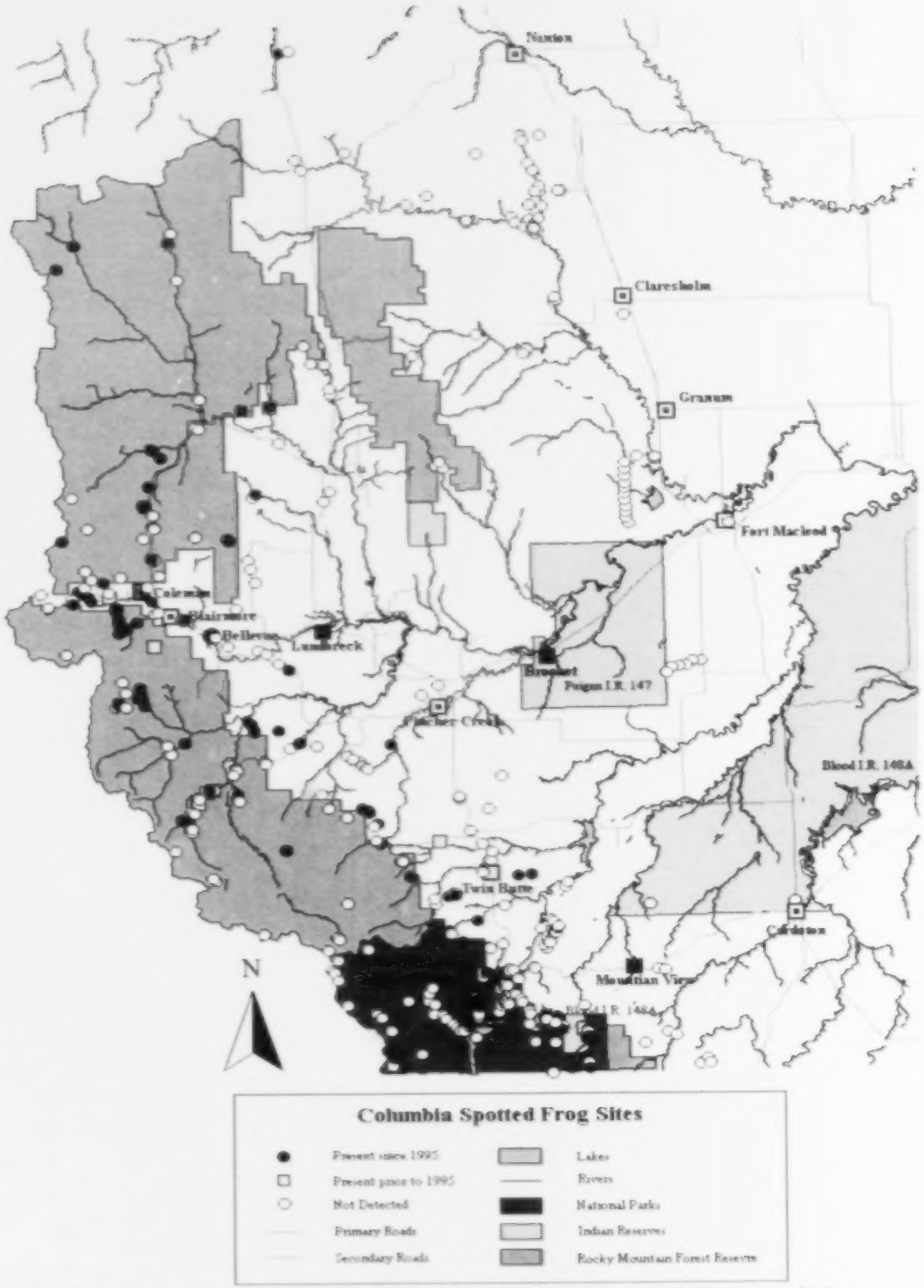

Figure 8. Columbia spotted frog distribution in the SHARP area and Waterton Lakes National Park.

Figure 7. Wood frog distribution in the SHARP area and Waterton Lakes National Park.

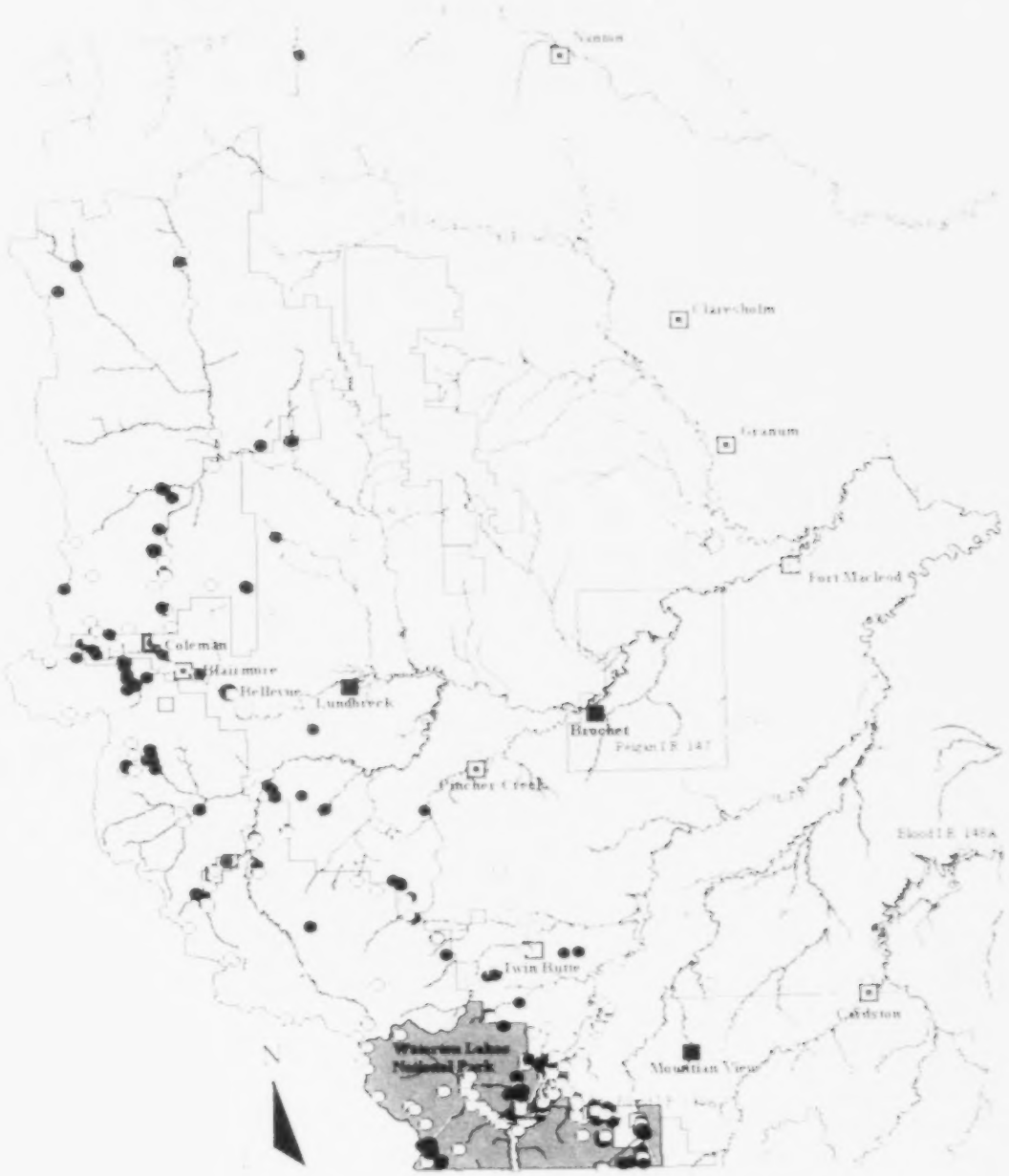

Figure 8. Columbia spotted frog distribution in the SHARP area and Waterton Lakes National Park.

sites where wood frogs were observed were located within the montane subregion. Columbia spotted frog (*Rana luteiventris*) was the most frequently-observed amphibian in the SHARP/WLNP region. That species was noted at 33% of sites surveyed since 1995 (Figure 8) and was observed mainly in the foothills parkland, montane and subalpine subregions, but also at a few sites in the fescue grassland.

3.2 Western Painted Turtles

Eleven western painted turtles were observed at one waterbody in the vicinity of Lee Lake. No turtles were detected at the other six waterbodies where turtle surveys took place. Several additional accounts of western painted turtle occurring throughout the Crowsnest Pass, Lee Lake and Beauvais Lake areas over the past few decades were recorded during conversations with Crowsnest Pass locals. This information has been summarized and provided separately to the Alberta Fish and Wildlife Regional Species At Risk Biologist in Lethbridge.

No definitive answers regarding the origins of the Crowsnest Pass area turtle populations arose as a result of conversations held with the area locals. A landowner in the Crowsnest Pass believed that the turtles observed on their property were intentionally introduced there. Conversely, a local naturalist believed that the turtles likely colonized the area from British Columbia through a series of interconnected waterbodies located throughout the Crowsnest Pass (D. McIntyre, pers. comm. 2004). This is supported by the fact that a life-long resident of the Lee Lake area and his family have observed turtles there since the 1920s. Another local has observed turtles laying eggs at Lee Lake; striped skunks (*Mephitis mephitis*) were subsequently observed preying upon the turtle eggs. The turtles' long-time presence at Lee Lake also presents the possibility that turtles were introduced there historically and have expanded westward through the Crowsnest Pass. This is supported by the fact that the known current distribution of the western painted turtle in British Columbia is not contiguous with the Alberta border in the vicinity of the Crowsnest Pass (British Columbia Species and Ecosystems Explorer 2003).

4.0 Discussion

Since 1995, SHARP area amphibian surveys have been concentrated in the mountains and foothills south of the Livingstone Gap, and a few localized areas in the fescue grassland region. To gain a more inclusive perspective on the distribution and status of amphibians in the SHARP area, future survey efforts should continue to focus on areas not previously surveyed for amphibians and those where possible species declines have occurred. In particular, additional surveys should be completed in the fescue grassland and mixed grassland subregions, the Porcupine Hills and the mountains and foothills north of the Livingstone Gap.

The amphibian species distributions depicted in Figures 1 through 8 approximate the generally-recognized ranges of those species in southwest Alberta (Russell and Bauer 1993). One unconfirmed long-toed salamander record exists for the Stavely area, which is

well outside of that species' known range. No amphibians were detected at that site in 2004. Many sites in the CSMA and WLNP where amphibians were not detected contained introduced trout, which are known to cause local extinctions of amphibian populations (Tyler et al. 1998; Funk and Dunlap 1999; Pilliod and Peterson 2001; Pearson 2004).

It is difficult to accurately assess species' status in the SHARP area from the limited spatial and temporal scales of the available data. In general, long-toed salamander, western toad, Columbia spotted frog and striped chorus frog appear to have been widely distributed in their respective subregions. Few wood frog and plains spadefoot observations have been made in the area prior to 2004. The plains spadefoot observations made in 2004 were the first recorded in the SHARP area since 1963. Since 1995 northern leopard frog occurred at relatively low proportions of the surveyed sites. Northern leopard frog is known to have declined significantly in Alberta over the past few decades (Kendell 2002), including the SHARP area and WLNP. Despite intensive surveys of historic northern leopard frog locations in the SHARP area and WLNP (Taylor and Smith 2003) in 2003 (178 sites surveyed), only one subadult frog was detected on provincial land. Successful breeding of northern leopard frog was observed in 2004 at a site where they had been observed in 1991 and 1992, but not during 2000-2001 surveys. Regular monitoring of amphibian populations throughout the SHARP area should continue in the long term.

Considering the current and potential conservation challenges that amphibians face, relatively little amphibian research has taken place in the SHARP area. Studies conducted in other environments are helpful in indicating the general effects of activities such as forestry and pesticide use on amphibians. However, local assessments of such issues would be valuable to the effective, long-term management of amphibians. Ongoing research efforts should be undertaken in the SHARP area to improve understanding of the effects of exotic species, pollution and habitat alteration on amphibians and related organisms. As much as possible, such studies should focus on both aquatic and terrestrial amphibian stages.

Further investigation is required to confirm the origins of western painted turtles in the SHARP area. The interviews conducted with area locals indicate that the turtles may have naturally colonized the Crowsnest Pass area from British Columbia, with some intentional introductions taking place as well. Alternatively, turtles may have been introduced in the area since at least the early 1900s, and subsequently dispersed throughout the area. The size of the population observed in the Lee Lake area, as well as observations of turtles breeding there by area locals, indicate that the population is self-sustaining. Additional turtle distribution surveys should be conducted in the Crowsnest Pass and Lee Lake area. Following the methods described by the British Columbia Ministry of Environment, Lands and Parks (1998), abundance surveys should be conducted at those sites where turtle populations are identified. It may also be helpful to seek Aboriginal Traditional Knowledge on the western painted turtle from members of the Piikani and Kainai First Nations. Finally, the most certain way to confirm the origins of the western painted turtle in the SHARP area would be to conduct DNA studies to

determine the genetic connection of SHARP area turtle populations to others in Alberta and BC.

5.0 Land Use Guidelines for Amphibian Habitat Protection in the SHARP Area

5.1 Background

5.1.1 Habitat Associations

Within the SHARP area, the long-toed salamander, western toad and Columbia spotted frog are typically associated with subalpine, montane and parkland subregions. Tiger salamander, northern leopard frog and striped chorus frog are associated with parkland, fescue and mixed grassland. Plains spadefoot are associated with the fescue and mixed grassland subregions, and wood frogs are associated with the montane region. In order to ensure the long-term conservation of amphibians in the SHARP area, both aquatic and terrestrial habitats must be adequately and appropriately protected within each subregion (Dodd and Cade 1998).

All amphibians in the SHARP area require standing waterbodies in which to breed. Virtually any permanent to semi-permanent, standing waterbody (i.e., very small, muddy ponds to large lakes) represents potential amphibian breeding habitat. Areas of very slow moving water may also be suitable (Corkran and Thoms 1996). Eggs are typically laid in water $\leq$ 1 m in depth and larvae remain aquatic throughout the larval period. Egg and larval development periods are typically shorter with higher water temperatures.

Once metamorphosis is complete, juvenile salamanders leave their natal ponds and, like adult salamanders, become fully terrestrial, only returning to waterbodies to breed. Adult and juvenile long-toed salamanders are known to utilize at least an 800 m radius surrounding their breeding waterbodies (Fukumoto 1995; Graham 1997; Powell et al. 1997). Long-toed salamanders hide under rocks and logs April through October, and utilize underground hibernaculae throughout the remainder of the year (Sheppard 1977). Juvenile and adult tiger salamanders spend the majority of time underground (Corkran and Thoms 1996; Stockstad 2004).

Juvenile western toads and frogs typically remain within or along the margins of their natal ponds (Corkran and Thoms 1996), though individual juveniles and adults may disperse up to several kilometres away to utilize other terrestrial habitats and waterbodies (Russell and Bauer 1993; Seburn and Seburn 1998; Wind and Dupuis 2002; Reaser and Pilliod 2003). Adult and juvenile Columbia spotted frogs, western toads and long-toed salamanders require terrestrial habitats with considerable vegetative cover, which provides protection from predators and appropriate temperature and moisture conditions. In winter months, western toads utilize underground hibernaculae (Wind and Dupuis 2002). Wood frogs hibernate on land, beneath litter and humus (Russell and Bauer 1993).

Striped chorus frogs also likely hibernate on land (Russell and Bauer 1993). Columbia spotted frogs overwinter in waterbodies (Reaser and Pilliod 2003).

Plains spadefoot undergo explosive breeding in spring following major precipitation events (Lauzon 1999). They are distributed primarily throughout the short-grass prairie and breed in shallow, often temporary wetlands (Russell and Bauer 1993). Throughout the year, adults and juveniles spend the majority of their time burrowed up to approximately 1 m deep in sandy soils (Russell and Bauer 1993).

5.1.2. Limiting Factors

A number of factors have the potential to negatively affect amphibian abundance and diversity within the SHARP region. These include, but are not limited to, climate change, habitat alteration, habitat fragmentation, predation, pollution, disease and introduced species. Habitat alteration, pollution and introduced species are currently considered to be the foremost threats to amphibian populations (Kiesecker 2003). While the most commonly-acknowledged threats, habitat alteration and pollution, can typically be easily halted or reversed, once introduced species become established, they are often permanent in nature (Kiesecker 2003).

Habitat Alteration

Numerous studies have examined the effects of forest harvest on amphibian species. Many have demonstrated that forest harvest practices tend to negatively impact amphibians (Naughton et al. 2000; Brooks 2001). This is most often described to be an effect of reduced forest cover and downed wood and the resultant changes in temperature and moisture conditions and the provision of cover. For example, Naughton et al. (2000) showed that the decrease in large, live trees associated with selective and overstory-removal logging was responsible for a threefold decrease in long-toed salamander abundance.

A number of studies have described that sizeable terrestrial areas adjacent to breeding waterbodies are necessary to maintain amphibian biodiversity (Sheppard 1977; Fukumoto 1995; Semlitsch 1998; Wind and Dupuis 2002; Reaser and Pilliod 2003). Alteration of those terrestrial areas through forest harvest would most likely result in reduced recruitment of juveniles into the breeding population, reduced adult survival, and therefore reduced likelihood of amphibian population persistence (Semlitsch 1998). Long-toed salamander, Columbia spotted frog and western toad thus require unharvested forest zones that extend a minimum of 400 m from the edge of breeding ponds (Sheppard 1977; Fukumoto 1995; Wind and Dupuis 2002; Reaser and Pilliod 2003).

Investigation into the habitat-altering effects of wildfire and prescribed burns on amphibians has shown that they have considerable spatial and temporal variation, and are incompletely understood (Pilliod et al. 2003; Bury 2004). The compaction and trampling of wetlands by cattle can result in direct amphibian mortality, the alteration of amphibian microhabitats and degraded water quality (Munger et al. 1997; Alberta Sustainable

Resource Development 2003). Microhabitat alteration may increase amphibian susceptibility to predation and reduce abundance of food.

Amphibian species are typically known to have metapopulation structure, where the migration of individuals between breeding habitats is required to maintain a network of populations (Sjogren 1991). Long-toed salamanders, western toads and Columbia spotted frogs require vegetated movement corridors that provide protection from predators and appropriate temperature and moisture conditions (Graham and Powell 1999; Wind and Dupuis 2002; Reaser and Pilliod 2003). Roadway mortality can be high for amphibians, especially when common migration corridors near breeding waterbodies are bisected by roads (Davis 2000; Carr and Fahrig 2001; Pearson 2001). Off-highway vehicles have been observed to drive right through and around the edges of important aquatic amphibian habitats in the SHARP area. Besides causing direct mortality to amphibian eggs, larvae and adults, this increases turbidity and pollutes waterbodies, which have further damaging effects on amphibians.

Introduced Species

Most standing waterbodies in the SHARP area are naturally fishless (Donald 1987). Amphibians in the SHARP area have therefore evolved primarily in the absence of fish and have not developed strategies that permit them to coexist with predatory fish. Non-predatory fish, such as minnows, may also indirectly impact amphibian populations through competition for food resources, or through altered amphibian behaviour (Pearson 2004). At low-elevation (< 1500 m) and high-elevation (≥ 1500 m) waterbodies in Waterton Lakes National Park and the Castle Special Management Area, the distribution of long-toed salamanders is strongly limited by introduced trout (Pearson 2004). Columbia spotted frogs are also negatively affected by introduced trout (Pilliod and Peterson 2001). Pilliod and Peterson (2001) projected that, by restricting amphibian populations to low-quality, shallow habitats, introduced trout had the potential to extirpate amphibian species from entire high-elevation basins. Goldfish introduced to wetlands by hobbyists eliminated amphibian populations from regular breeding habitats in Idaho (Monello and Wright 2001). Trout stocking has also been documented to result in the introduction of pathogens that may cause amphibian declines (Kiesecker et al. 2001; Muths et al. 2003).

Introduced from eastern North America circa 1940, bullfrogs (*Rana catesbeiana*) currently inhabit the lower mainland and southern Okanagan regions of British Columbia, as well as the Bitterroot Mountains of Montana (Price 1998). Several studies have documented highly negative effects of bullfrogs on native amphibian populations (Hayes and Jennings 1986; Lawler et al. 1999; Ashpole, pers. comm. 2005). Bullfrog population increases in California and British Columbia have been correlated with declines in native frog species (Kiesecker and Blaustein 1998; Price 1998). Though bullfrogs do not currently inhabit the SHARP area, potential exists for populations to become established by natural range expansion and via intentional introductions.

Pollution and Disease

A variety of pesticides have been shown to cause mortality and impair sexual development in amphibians (Eroschenko 2002). For example, some ammonia- and surfactant-based fire retardants and fire suppressant foams applied during wildland fire suppression activities may be highly toxic to amphibians (Pilliod et al. 2003). Spray irrigation of chlorinated wastewater effluent can result in reduced survival of amphibian eggs and larvae (Laposata and Dunson 2000).

The extent to which disease affects amphibians is poorly understood; few amphibian disease outbreaks have been noted in Canada (Crawshaw 1997). However, potential exists for disease to negatively impact amphibians in the SHARP area. Massive tiger salamander die-offs have occurred in Saskatchewan and the United States in recent decades as a result of bacteria (*Acinetobactor*) and Ranavirus (Worthylake and Hovingh 1989; Bollinger et al. 1999). A series of environmental factors and immunosuppression are thought to increase the impact of regularly-occurring diseases on amphibian populations (Carey 1993).

5.2 Land Use Guidelines

Implementation of the following land use guidelines is recommended for the protection of amphibian habitat in the SHARP area:

Forest Management

- In order to protect terrestrial amphibian habitat in the mountain and foothill regions of the SHARP area, unharvested buffer zones of at least 400 m radius should remain around all standing waterbodies.

- In order to permit effective migration of long-toed salamander, Columbia spotted frog and western toad between breeding waterbodies, a network of non-harvested corridors should remain intact between all standing waterbodies and their surrounding buffers. Corridors should be at least 100–200 m in width.

- To minimize amphibian mortality within a 1 km radius of standing waterbodies, forestry operations should only take place in those areas November through March, when long-toed salamanders and western toads are protected in underground hibernaculae and Columbia spotted frogs are hibernating in waterbodies.

- Land managers should keep apprised of results of emerging research on the effects of wildfire and prescribed burning on amphibians, and apply resulting management recommendations. Wherever possible, efforts should be made to contribute to the growing body of knowledge on the effects of fire on amphibians.

- During fire control operations, ensure that fire retardants and fire suppressant foams are not released directly into waterbodies.

Introduced Species

- The stocking of any fish species (trout, bass, minnows, etc.) into any naturally fishless waterbodies should be avoided.

- Bait bans should be strictly enforced to prevent the establishment of minnow populations through their use as bait.

- The planned stocking of fish into standing waterbodies should be discontinued.

- Habitats containing self-reproducing, stocked trout populations should be restored to their original fishless states.

- Educate the public on the negative effects of introducing hobby fish into amphibian habitats and effectively enforce any restrictions on doing so.

- Natural amphibian colonization of restored habitats should be monitored. Egg or larval translocation may be necessary to re-establish amphibian populations in more isolated areas or areas where amphibian populations have severely declined.

- Closely monitor the status of introduced bullfrogs in Alberta, and immediately eradicate any populations that do become established. It may be valuable to partner with British Columbia and Montana agencies in controlling any bullfrog populations that become established in the vicinity of the Alberta border.

- Prohibit the establishment of bullfrog farms in Alberta and restrict the introduction of bullfrogs.

Recreation

- Restrict and enforce the restriction of Off Highway Vehicles from travelling through or in the immediate vicinity of standing waterbodies of any size or description.

- Erect and maintain fences around waterbodies that chronically have vehicle trails through or near them.

Agriculture

- Protect amphibian breeding ponds from high-impact livestock use by providing alternative water sources, or by fencing ponds and restricting access to concentrated areas.

- When constructing new livestock watering sources (i.e. dugouts), avoid creating connections with fish-bearing creeks or rivers, which may be a source of fish that lower the value of the newly-created habitat for amphibians.

- Avoid the use of pesticides within at least 100 m of standing waterbodies.

- Discourage the filling or draining of wetlands.

Stewardship

- Encourage landowners to create or maintain fish-free ponds that can be used by amphibians.

- Encourage landowners to take part in the Alberta Amphibian Monitoring Program and act as stewards of their amphibian habitats.

- Encourage landowners to participate in riparian management programs such as "Cows and Fish".

Roadway Mortality

- Monitor locations where amphibians (primarily tiger salamanders and long-toed salamanders) migrate across existing roadways between terrestrial and aquatic habitats.

- If high rates of amphibian mortality are documented at existing road crossings, build under-road crossing structures or close the roadways temporarily during the migration periods.

- Important amphibian habitats (i.e. breeding ponds, terrestrial habitat, migration routes) should be a major consideration in the planning and development of new roadways. New roadways should be aligned to avoid such habitats.

Other

- To prevent the spread of pathogens that may harm amphibians, individuals who repeatedly enter amphibian habitats for research or monitoring should follow the equipment cleaning protocol established by the Declining Amphibian Populations Task Force (DAPTF).

- Enhance enforcement of the illegal harvest of amphibians from natural habitats.

- Educate the public and educators on the negative impacts of taking amphibians from the wild as pets. Discourage the return of any captive-raised amphibians to locations other than where they were taken.

6.0 Literature Cited

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Appendix A. Definition of species designations by Alberta Sustainable Resource Development, Alberta Natural Heritage Information Centre and Committee on the Status of Endangered Wildlife in Canada, including those in Table 1.

Alberta Sustainable Resource Development (ASRD) Status Categories (ASRD 2000)

At Risk: Any species known to be "At Risk" after formal detailed status assessment and designation as "Endangered" or "Threatened" in Alberta

May Be At Risk: Any species that "May Be At Risk" of extinction or extirpation, and is therefore a candidate for detailed risk assessment.

Sensitive: Any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from becoming at risk.

Secure: A species that is not "At Risk", "May Be At Risk" or "Sensitive".

Undetermined: Any species for which insufficient information, knowledge or data is available to reliably evaluate its general status.

Alberta Natural Heritage Information Centre (ANHIC) Ranks (ANHIC 2004)

S1: 5 or fewer occurrences or only a few remaining individuals. May be especially vulnerable to extirpation because of some factor of its biology.

S2: 6–20 or fewer occurrences or with many individuals in fewer locations. May be especially vulnerable to extinction because of some factor of its biology.

S3: 21–100 occurrences may be rare and local throughout its range, or in a restricted range (may be abundant in some locations). May be susceptible to extirpation because of large-scale disturbances.

S4: Typically > 100 occurrences. Apparently secure.

S5: Typically >100 occurrences. Demonstrably secure.

Committee on the Status of Endangered Wildlife in Canada Designations (COSEWIC 2004)

Endangered: A wildlife species facing imminent extirpation or extinction.

Threatened: A wildlife species likely to become endangered if limiting factors are not reversed.

Special Concern: A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Not At Risk: A species that has been evaluated and found to be not at risk of extinction given the current circumstances.